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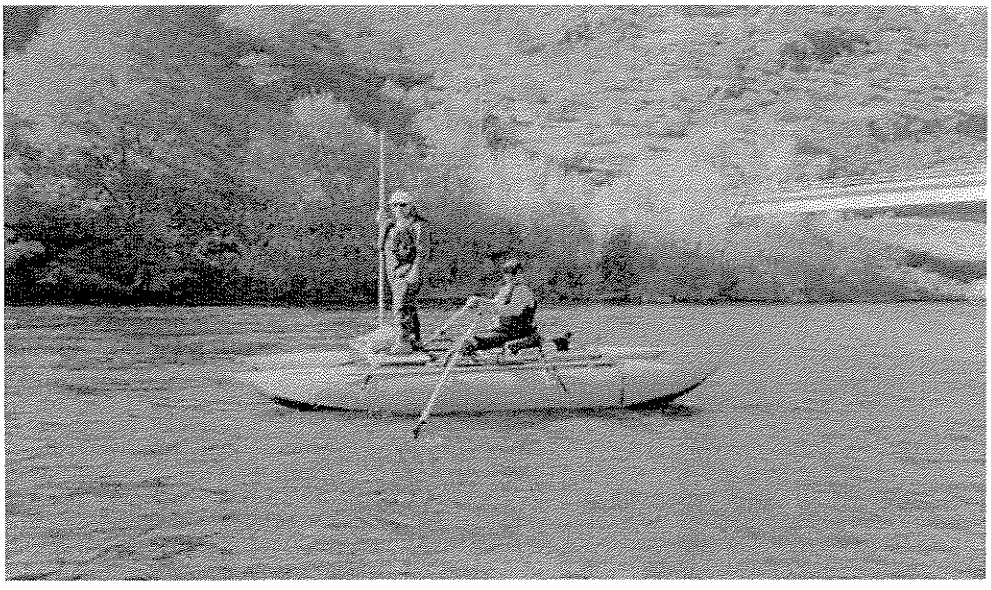
Mainstem Klamath River Fall Chinook Spawning Survey

Fiscal Year 2000

U.S. Fish and Wildlife Service
Arcata Fish & Wildlife Office
Arcata, California

Prepared by:

Mark Magneson
Dennis Therry
Tom Shaw



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DISCLAIMER

Mention of trade names or commercial products in this report does not constitute endorsement by the U.S. Fish and Wildlife Service (USFWS).

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ABSTRACT

This report describes observations and results of the seventh annual U.S. Fish and Wildlife Service fall chinook salmon (*Oncorhynchus tshawytscha*) spawning survey on the upper mainstem Klamath River. The survey was conducted for six consecutive weeks from October 13 to November 19, 1999, covering 134.8 river kilometers between Iron Gate Dam and the confluence of Indian Creek at Happy Camp. A total of 989 redds were observed during the 1999 survey which represents a 30% decrease from the 1998 redd count, and the fourth consecutive year of declining redd numbers.

In 1999, spawning was observed throughout the mainstem Klamath River from Iron Gate Dam to Indian Creek with approximately 73% (n=718) of the redds located between Iron Gate Dam and the Shasta River. Since 1993, the tendency for chinook to spawn within the upper 10 river km (Iron Gate Dam to Cape Horn Creek), has increased from 24 to 61%. Redd density in this upper mainstem section was 60.2 redds/rkm. The lowest redd densities in 1999 were between Shinar and China Creek (0.3 redds/rkm).

During 1999, only one redd was observed on suction dredge tailings between Iron Gate Dam and Indian Creek.

INTRODUCTION

The Klamath River drains approximately 14,000 km² in Oregon and 26,000 km² in California. The majority of the watershed in California is within the boundaries of the Six Rivers, Klamath and Shasta-Trinity National Forests. The Yurok Indian Reservation, comprising approximately 139 km² in Humboldt and Del Norte counties, borders the lower 68 km of the Klamath River (Figure 1). The most important anadromous salmonid spawning tributaries in the basin include the Trinity River (the largest tributary in the basin) draining approximately 7,690 km², and the Shasta, Scott and Salmon rivers, each draining approximately 2,070 km². Iron Gate Dam (IGD) (rkm 306) on the Klamath River and Lewiston Dam (rkm 249) on the Trinity River represent the upper limits of anadromous salmonid migration in the basin. Iron Gate Hatchery (IGH) and Trinity River Hatchery, located near the base of each dam, were constructed as mitigation for natural fish production losses resulting from each project (USFWS 1991).

The Klamath River Basin has historically supported large runs of chinook salmon (*Oncorhynchus tshawytcha*), coho salmon (*O. kisutch*), and steelhead trout (O. *mykiss*), which have contributed considerably to subsistence, sport and commercial fisheries in California. Generations of Indians have utilized fishing grounds in the drainage, and their fisheries for salmon, steelhead and sturgeon have historically provided the mainstay of the Indian economy in the area. Sport fishing for salmon and steelhead in the drainage may exceed 200,000 angler days annually. During the 1980's, the Klamath River stocks accounted for up to 30% of commercial chinook salmon landings in northern California and Southern Oregon and averaged 450,000 chinook per year (PFMC 1988).

Concern about the depletion of anadromous salmonid resources and associated habitat in the basin emerged around the turn of the century, and has accelerated in recent decades coincident with expanded logging and fishing operations, dam building activity, road construction and other development. As in other river systems of the Pacific Northwest, chinook salmon of the Klamath River Basin have experienced the continued effects of habitat degradation and over-exploitation as reflected by declining runs in recent decades (USFWS 1991).

On October 27, 1986 the Congress enacted P.L. 99-552, the Klamath River Fish and Wildlife Restoration Act. This action authorized the Secretary of the Interior to restore the anadromous fish populations to optimum levels in both the Klamath and Trinity Rivers through a habitat restoration program and formation of the Klamath River Fishery Management Council (USFWS 1991).

The U.S. Fish and Wildlife Service (USFWS) was funded through the Klamath River Fish and Wildlife Restoration Program to identify fall chinook spawning areas and collect information necessary to estimate the natural fall chinook spawning escapement on the mainstem Klamath River between IGD and the confluence of Indian Creek.

MATERIALS AND METHODS

Survey Procedures

The Arcata Fish and Wildlife Office (AFWO) mainstem Klamath River redd survey protocol consisted of six mainstem reaches (Figure 2) covering 134.8 (rkm) (83.8 river miles). The six reaches were surveyed weekly from IGD to the confluence of Indian Creek, unless adverse weather limited the visibility of the water to less than one meter in depth. Each crew covered the same survey reaches each week to remain familiar with each survey reach and prior redd locations.

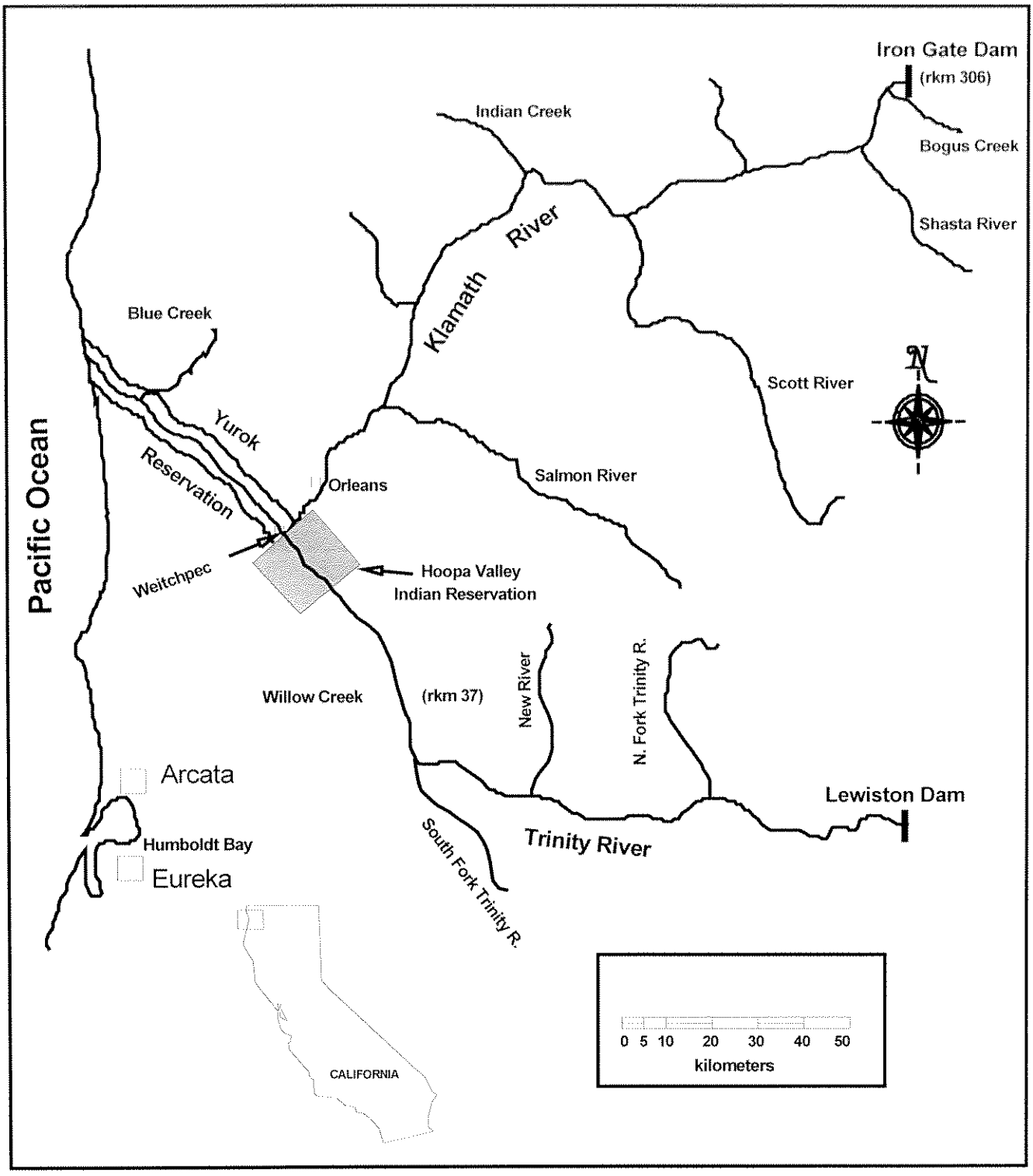

Figure 1. Overview map of the Klamath River Basin accessible to anadromous fish.

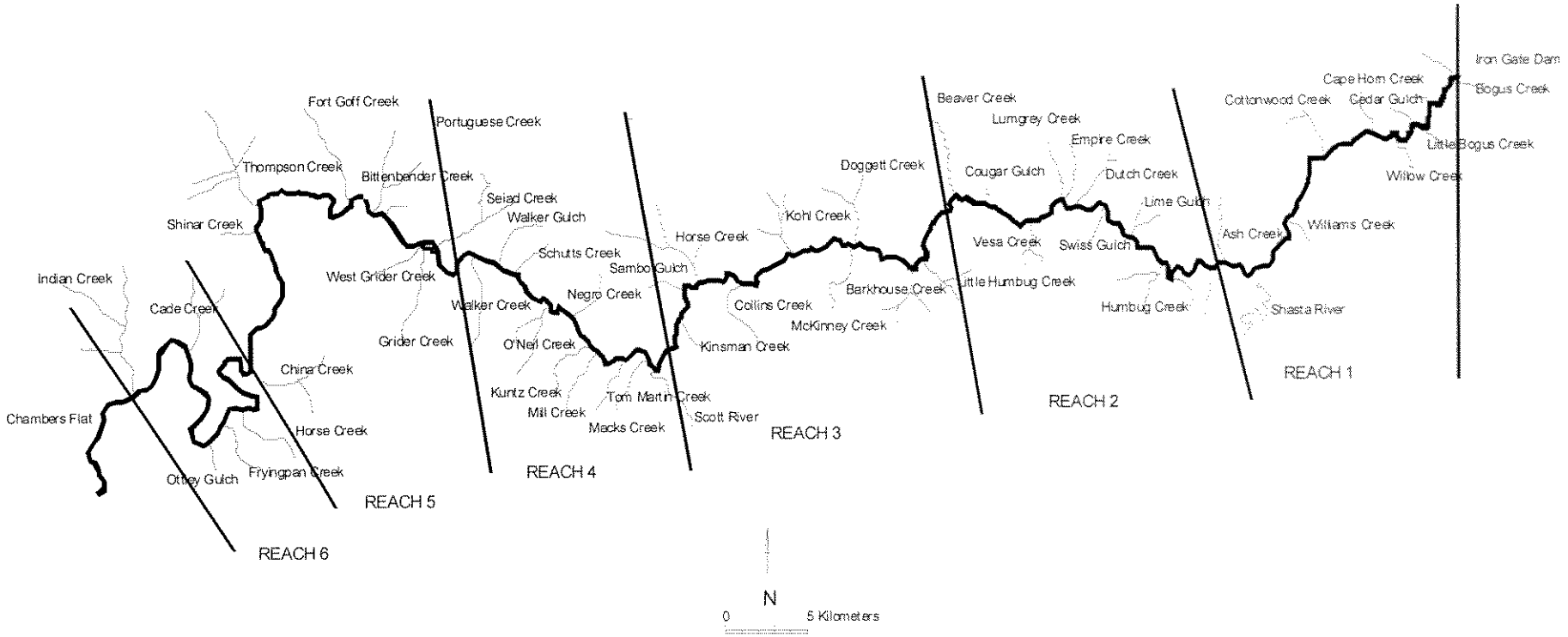

Figure 2. Mainstem Klamath River chinook spawning survey project location including individual study reaches (1 to 6).

Rafting Equipment

Two 4.57 m (15 foot) inflatable Wing Catarafts were used for direct observation of fall chinook salmon redds. These rafts were noted for use in white water rescue due to their stability and maneuverability in fast water. The rafts were stacked on a flat trailer and deployed at selected access sites along the study area. Each raft was equipped with a rowing frame, a modified observation platform, and anchoring system. Two personnel operated each raft (rower and observer).

Survey Equipment

Plastic survey flagging tape was used to mark individual redds and redd clusters along the river bank in each reach. Polarized sunglasses and baseball style caps were used to reduce glare and improve visibility into the water. A removable wooden measuring rod (2.4 m) was mounted upright on each cataraft to help observers balance while standing up and to measure redds. During the fifth (November 9 to 12) and sixth week (November 15 to 19) of the survey, crews marked the location of individual and redd clusters with a Rockwell International, Precision Global Positioning System Receiver.

Reaches 1 to 6

Reach 1: IGD river access (rkm 306.1) to Ash Creek river access (rkm 281.6) (Figure 2).

This reach is 24.5 rkm (15.2 miles) in length and was surveyed over a period of two days (Monday and Tuesday). Due to the high percentage of redds in Reach 1, two cataraft crews surveyed the entire reach from IGD to Deliverance Camp river access (rkm 283.1). One crew surveyed the left bank to mid-channel while the second crew surveyed from the right bank to mid-channel. A section of Reach 1 from the Interstate 5 (I-5) bridge (rkm 288.4) to the Deliverance Camp river access (rkm 283.1) was surveyed the first day (Monday). This stretch took less than two hours to survey. The section from Deliverance Camp river access to Ash Creek river access (rkm 281.6) was not surveyed because past surveys have revealed no redds in this stretch. On the second day, the survey resumed from the IGD river access to the I-5 bridge. This reach was completed in eight to ten hours. Reach 1 was surveyed each week for six consecutive weeks (Week 1 to 6) (Table 1).

Reach 2: Ash Creek river access to Beaver Creek riffle river access (rkm 257.1) (Figure 2).

This reach is 24.5 rkm (15.2 miles) in length. The Beaver Creek riffle river access is located along the right bank on a large gravel bar downstream from Beaver Creek bridge, just off Highway 96. One crew surveyed this reach on the third day (Wednesday) which required approximately seven hours to complete. During Week 1, only a partial survey from Ash Creek river access to the boat ramp at Trees of Heaven Campground (rkm 276.0) was completed. Complete surveys were conducted for five consecutive weeks from Week 2 to 6 (Table 1).

Reach 3: Beaver Creek river access to Blue Heron river access (rkm 230.0) (Figure 2).

The reach is 27.1 rkm (16.2 miles) in length. The Blue Heron river access is approximately two rkm upstream from the Scott River confluence. This reach was surveyed by one crew on the third day (Wednesday) in approximately eight hours (Table 1). This reach was surveyed for five consecutive weeks from Week 2 to 6.

Table 1. Weekly summary and percent frequency of mainstem Klamath River redd counts for Reaches 1 to 6, 1993 to 1999 (NS = No Survey).

	Reach 1 Iron Gate Dam to Ash Creek River Access	Reach 2 Ash Creek River Access to Beaver Creek Riffle River Access	Reach 3 Beaver Creek Riffle to Blue Heron	Reach 4 Blue Heron River Access to Seiad Bar River Access	Reach 5 Seiad Bar River Access to China Point	Reach 6 China Point to Indian Creek River Access	Weekly Total
Year	1993						
Week 1 Oct 25 to 29	15	13	30	18	16	81	173
Week 2 Nov 1 to 5	67	24	4	1	15	5	116
Week 3 Nov 8 to 12	5	1	18	7	0	1	32
Week 4 Nov 15 to 18	0	0	4	5	0	0	9
Total	87	38	56	31	31	87	**330**
% Frequency	26	12	17	9	9	26	
Year	1994						
Week 1 Oct 17 to 21	89	28	48	NS	NS	98	263
Week 2 Oct 24 to 28	278	59	77	113	98	124	749
Week 3 Oct 31 to Nov 4	375	20	46	42	16	33	532
Week 4 Nov 7 to 11	86	NS	NS	NS	NS	NS	86
Week 5 Nov 14 to 18	3	2	7	4	5	5	26
Total	831	109	178	159	119	260	**1656**
% Frequency	50	7	11	10	7	16	
Year	1995						
Week 1 Oct 16 to 20	138	12	70	26	30	139	415
Week 2 Oct 23 to 27	598	82	199	94	91	169	1233
Week 3 Oct 30 to Nov 3	727	58	78	35	57	112	1067
Week 4 Nov 6 to 10	277	26	49	13	25	50	440
Week 7 Nov 27 to Dec 1	39	9	14	4	12	3	81
Total	1779	187	410	172	215	473	**3236**
% Frequency	55	6	13	5	7	15	
Year	1996						
Week 1 Oct 21 to 25	290	31	96	10	118	39	584
Week 2 Oct 28 to Nov 1	291	29	25	22	42	92	501
Week 3 Nov 4 to 8	83	4	24	8	33	59	211
Week 4 Nov 11 to 15	40	0	6	0	7	23	76
Total	704	64	151	40	200	213	**1372**
% Frequency	51	5	11	3	15	16	

Table 1 (continued). Weekly summary and percent frequency of mainstem Klamath River redd counts for Reaches 1 to 6, 1993 to 1999 (NS = No Survey).

	Reach 1 Iron Gate Dam to Ash Creek River Access	Reach 2 Ash Creek River Access to Beaver Creek Riffle River Access	Reach 3 Beaver Creek Riffle to Blue Heron	Reach 4 Blue Heron River Access to Seiad Bar River Access	Reach 5 Seiad Bar River Access to China Point	Reach 6 China Point to Indian Creek River Access	Weekly Total
Year	1997						
Week 1 Oct 16	272	NS	NS	NS	NS	NS	272
Week 2 Oct 20 to 24	252	37	69	89	29	136	612
Week 3 Oct 27 to 31	424	18	76	52	22	76	668
Week 4 Nov 3 to 7	70	7	13	16	8	27	141
Week 5 Nov 10 to 14	2	14	4	5	3	18	46
Total	1020	76	162	162	62	257	**1739**
% Frequency	59	4	9	9	4	15	
Year	1998						
Week 1 Oct 14 to 15	89	NS	NS	NS	NS	NS	89
Week 2 Oct 19 to 23	180	45	67	15	20	45	372
Week 3 Oct 26 to 30	368	11	12	14	7	39	451
Week 4 Nov 2 to 6	226	22	33	10	9	28	328
Week 5 Nov 9 to 12	135	3	11	3	2	2	156
Week 6 Nov 15 to 19	12	1	3	0	1	2	19
Total	1010	82	126	42	39	116	**1415**
% Frequency	71	6	9	3	3	8	
Year	1999						
Week 1 Oct 13 to 15	98	3	NS	NS	NS	NS	101
Week 2 Oct 18 to 22	200	27	31	17	23	39	337
Week 3 Oct 25 to 27	304	23	20	NS	NS	NS	347
Week 4 Nov 1 to 5	83	12	9	8	8	19	139
Week 5 Nov 8 to 12	37	2	2	1	5	11	58
Week 6 Nov 15 to 19	1	2	0	2	2	0	7
Total	723	69	62	28	38	69	**989**
% Frequency	73	7	6	3	4	7	

Reach 4: Blue Heron river access to Seiad Bar river access (rkm 211.2) (Figure 2).

This reach is 18.8 rkm (11.3 miles) in length. The Seiad Bar river access is located along the right bank of the Klamath River. River access was acquired approximately 2.7 rkm downstream of the access point used in past spawner surveys. The river access is acquired by taking the road to the right of the California Department of Transportation's compound. The reach boundaries remain the same as those from past years. This reach was surveyed on the fourth day (Thursday) by one cataraft crew in approximately eight hours. This reach was surveyed during Weeks 2,4,5 and 6. No surveyed was conducted during Week 3 due to poor water clarity (<1.0m) conditions due to a storm event (Table 1).

Reach 5: Seiad Bar river access to China Point river access (188.5) (Figure 2).

This reach is 22.7 rkm (13.6 miles) in length. China Point river access is located along the right bank of the river, at the U.S. Forest Service (USFS) river access just off Highway 96. One cataraft crew surveyed this reach on the fourth day (Thursday) in approximately seven hours. This reach was surveyed during Weeks 2,4,5 and 6. No surveyed was conducted during Week 3 due to poor water clarity (Table 1).

Reach 6: China Point river access to the Indian Creek confluence (rkm 169.4) (Figure 2).

This reach is 19.1 rkm (11.4 miles) in length. Due to the high concentration of redds in this area, this reach was split at Gordons Ferry river access (rkm 180.4). China Point river access to Gordons Ferry river access is 7.2 rkm (4.5 miles). Gordons Ferry river access to Indian Creek confluence is 11.5 rkm (7.1 miles). The Gordons Ferry river access is located along the right bank (looking downstream) of the river at the USFS river access just off Highway 96. This reach is covered by two crews on the fifth day (Friday) with each section taking approximately five hours to survey. The reach was surveyed during Weeks 2,4,5 and 6. No surveyed was conducted during Week 3 due to poor water clarity (Table 1).

10 km Sections

In order to describe the frequency of spawning redd occurrence, in percentages, by yearly redd counts, the mainstem Klamath River between IGD and the confluence of Indian Creek was broken into 14 river sections approximately 10 rkm long (Table 2).

Redd Data

The date, number of redds/site, location in channel, and redd site number were recorded on each flag. Flags were tied to the bank nearest the redd. A different color flagging was used each week to ensure that redds were not double counted during the course of the survey. Redd sites were also recorded on river maps and on data forms. Data recorded included: GPS mark number, tally number, location in channel (left or right bank, middle, side channel, split channel and pool tail-out), distance from bank, defended area (distance between redds in a cluster), number of adults and grilse, flag location, water temperature, weather conditions, river reach, and age of redd code.

Estimated redd ages were recorded as Redd Age Code 1, 2 or 3 depending on appearance. Fresh redds with bright substrate, little or no periphyton, and well-developed mounds were classified as Redd Age Code 1. Redds 2 to 4 weeks old with slightly flattened mounds and dulled substrate due to periphytonic growth were classified as Redd Age Code 2. Redds older than four weeks which were identifiable only by pit and/or mound presence and typically could not be distinguished from surrounding substrate by brightness differences, were classified as Redd Age Code 3. Only completed redds (which included both a pit and mound) were included in the daily counts. Test redds and small (<1.0 m^2) redds were omitted.

Table 2. Percent redd frequency by 10 rkm (approximate) section on the mainstem Klamath River, 1993 to 1999.

TRIBUTARY REACH (rkm)	REACH DISTANCE (rkm)	PERCENT FREQUENCY						
		1993	1994	1995	1996	1997	1998	1999
Iron Gate (306.1) to Cape Horn Ck (269.4)	10	24.2	38.9	39.1	40.9	45.0	55.1	**60.9**
Cape Horn Ck (269.4) to Shasta River (284.3)	12	2.1	11.1	15.6	10.6	14.2	16.1	**11.7**
Shasta River (284.3) to Humbug Ck (275.8)	9	2.7	1.1	1.9	0.8	1.1	3.0	**3.3**
Humbug Ck (275.8) to Vesa Ck (264.5)	11	5.5	2.2	1.1	1.1	1.8	1.6	**2.9**
Vesa Ck (264.5) to Little Humbug Ck (254.4)	10	5.8	6.9	5.2	4.8	3.3	3.0	**2.9**
Little Humbug Ck (254.4) to Kohl Ck (244.9)	10	7.9	3.4	4.9	3.3	4.3	3.0	**0.9**
Kohl Ck (244.9) to Kinsman Ck (234.2)	11	7.9	2.7	4.9	4.2	2.3	4.3	**3.3**
Kinsman Ck (234.2) to Kuntz Ck (224.4)	10	2.4	4.2	1.2	2.4	0.9	0.4	**1.2**
Kuntz Ck (224.4) to Walker Ck (214.4)	10	6.4	5.6	3.8	1.8	8.6	2.5	**1.9**
Walker Ck (214.4) to Portuguese Ck (205.3)	9	7.6	5.2	3.9	5.5	1.0	1.0	**2.1**
Portuguese Ck (205.3) to Shinar Ck (199.0)	10	1.2	3.9	2.2	3.1	1.4	1.4	**1.6**
Shinar Ck (199.0) to China Ck (189.8)	9	6.7	2.2	4.4	6.0	1.8	0.4.	**0.3**
China Ck (189.8) to Ottley Gulch (181.1)	9	12.4	7.1	6.0	10.7	6.5	4.7	**3.6**
Ottley Gulch (181.1) to Indian Ck (171.3)	10	7.3	5.4	5.8	4.8	7.6	3.5	**3.0**

Water Temperature

Water temperature was recorded using a Optic Stowaway Tidbit on an hourly basis throughout the survey period at the downstream end of R-Ranch (5.5 rkm downstream of IGD). Hourly data were used to calculate the mean daily water temperatures.

Discharge

Mean daily river flow was provided by the U.S. Geological Survey gaging station (Number 11516530), located in the Klamath River just downstream of IGD. Daily river flow was measured in cubic feet per second (cfs)

Water Clarity

A 20 cm diameter Secchi disc was used daily throughout the surveys to measure water clarity. Water clarity was measured by lowering a Secchi disc vertically into the water column. The disc was lowered until the

black and white pattern on the disc was not discernable. The disc was then raised until the pattern was just vaguely discernable, and this depth was recorded in meters.

Adult Grilse Expansion

The total number of redds counted by AFWO during these surveys was doubled by California Department of Fish and Game (CDFG) and assumed to equal the total number of natural fall chinook spawners in the mainstem Klamath River. This estimate assumes there is only one male and female salmon per redd.

RESULTS AND DISCUSSION

Redd surveys were conducted weekly from October 13 to November 19, 1999. A total of 989 chinook salmon redds were counted between IGD and the confluence of Indian Creek, representing a 30% decline from the 1998 count of 1,415 (Figure 3, Table 1). Based on field maps and notes from the survey, locations of redds for all reaches surveyed are shown in Figures 4 to 7.

Reaches 1 to 6

Reach 1: IGD to Ash Creek river access.

A total of 723 redds were observed in this reach representing a redd density of 29.5 redds/rkm (Figure 4). The 723 redds represent 73% of the total redd count for 1999. This is the highest percentage of redd counts in Reach 1 since 1998 (71%). Based on weekly redd counts, peak spawning occurred during Week 3 (Table 1). Fishing pressure by recreational drift boat and bank anglers was higher in this reach than in reaches downstream.

Reach 2: Ash Creek river access to Beaver Creek Riffle river access.

A total of 69 redds were counted in this reach during the 1999 survey (Figures 4 and 5). Redd density was 2.8 redds/rkm. Peak spawning occurred during Week 2 of the survey. Spawning may have peaked earlier but only a partial survey was conducted during Week 1 with full surveys being initiated during Week 2 (Table 1).

Reach 3: Beaver Creek Riffle river access to Blue Heron river access.

A total of 62 redds were counted in this reach which represents a redd density of 2.3 redds/rkm (Figure 5). The 62 redds counted is the second lowest count for this reach since the project started in 1993. Peak spawning occurred during Week 2. Spawning may have peaked earlier but surveys did not begin in this reach until Week 2 (Table 1).

Reach 4: Blue Heron river access to Seiad Bar river access.

A total of 28 redds were counted in this reach which represents 1.5 redds/rkm (Figures 5 and 6). Peak spawning in Reach 4 occurred during Week 2. Spawning may have peaked earlier, but wasn't noted until the surveys were initiated during Week 2. The total number of redds observed during Week 4 includes potential redds from Week 3, because no surveys were conducted in this reach during Week 3. (Table 1).

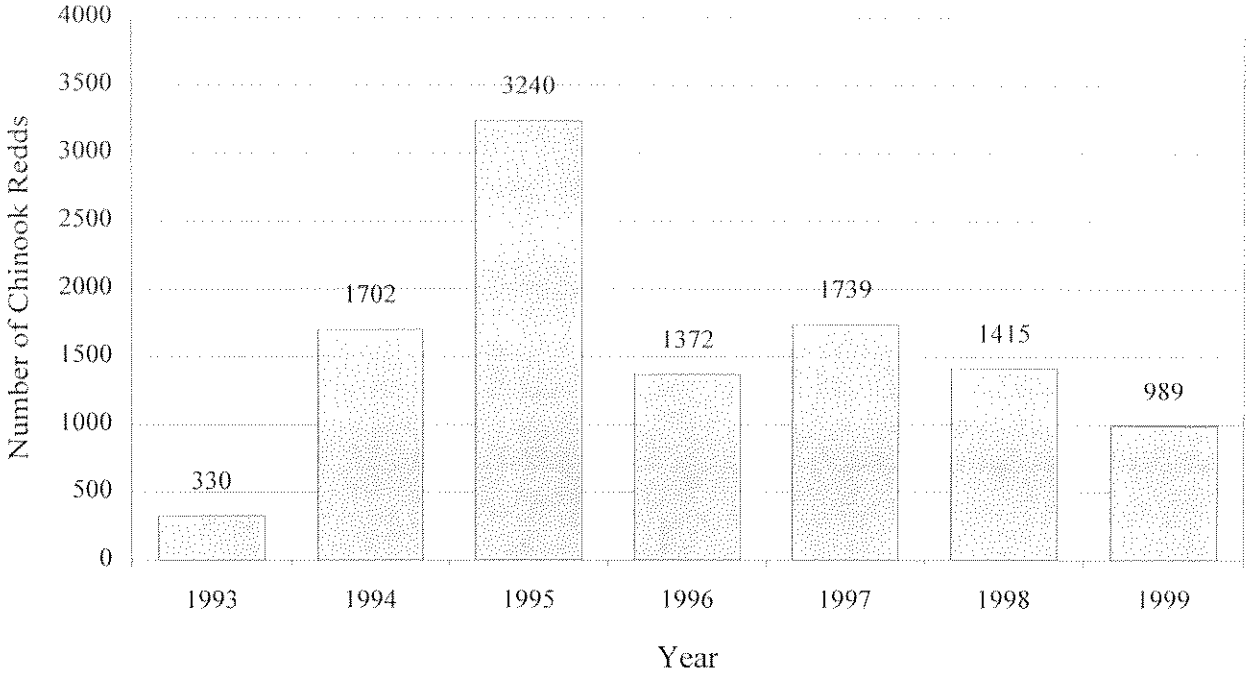

Figure 3. Yearly USFWS chinook salmon redd counts, 1993 to 1999.

Reach 5: Seiad Bar river access to China Point river access.

A total of 38 redds were counted in this reach, which represents 1.7 redds/rkm (Figures 6 and 7). The 1999 count is the lowest redd count ever observed for this reach. Peak spawning occurred during Week 2 of this survey. Spawning may have peaked earlier but surveys did not begin until Week 2. The total number of redds observed during Week 4 includes redds made the prior week because surveys were not conducted in this reach during Week 3 (Table 1).

Reach 6: China Point river access to Indian Creek.

A total of 69 redds were counted in Reach 6 (Figure 7). This represents a redd density of 3.6 redds/rkm and the lowest redd count for this reach since the beginning of this study. Peak spawning in Reach 6 occurred during Week 2. Spawning may have peaked earlier but surveys did not begin until Week 2. The total number of redds observed during Week 4 includes potential redds from the prior week, because surveys were not conducted in this reach during Week 3 (Table 1).

Spawning was observed throughout the mainstem river from IGD to Indian Creek and was consistent with previous survey data in that spatial distribution of redds is increasing in the upper mainstem (IGD to Ash Creek river access). The highest weekly redd count occurred during Week 3 although Reaches 4, 5 and 6 were not sampled. Reach 4 had the lowest redd count (28) of any reach sampled in 1999 (Table 1).

10 km Sections

Redd counts were highest between IGD and Cape Horn Creek (Copco-Ager Bridge) with a redd density of 60.2 redds/rkm. The redd frequencies in this section increased from 24 to 61% during the last seven years,

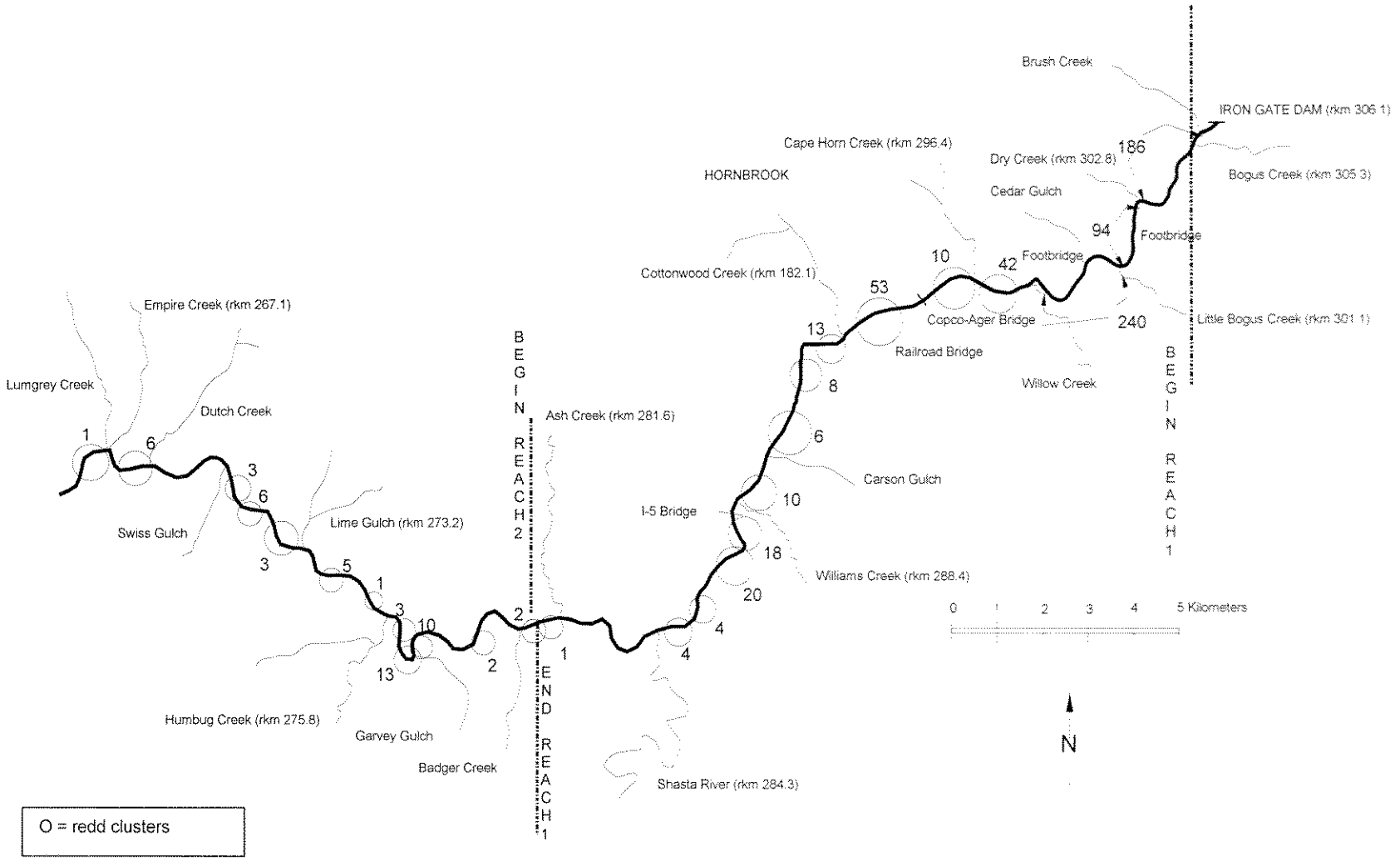

Figure 4. Redd distribution map for 1999, mainstem Klamath River, Iron Gate Dam to Lumgrey Creek.

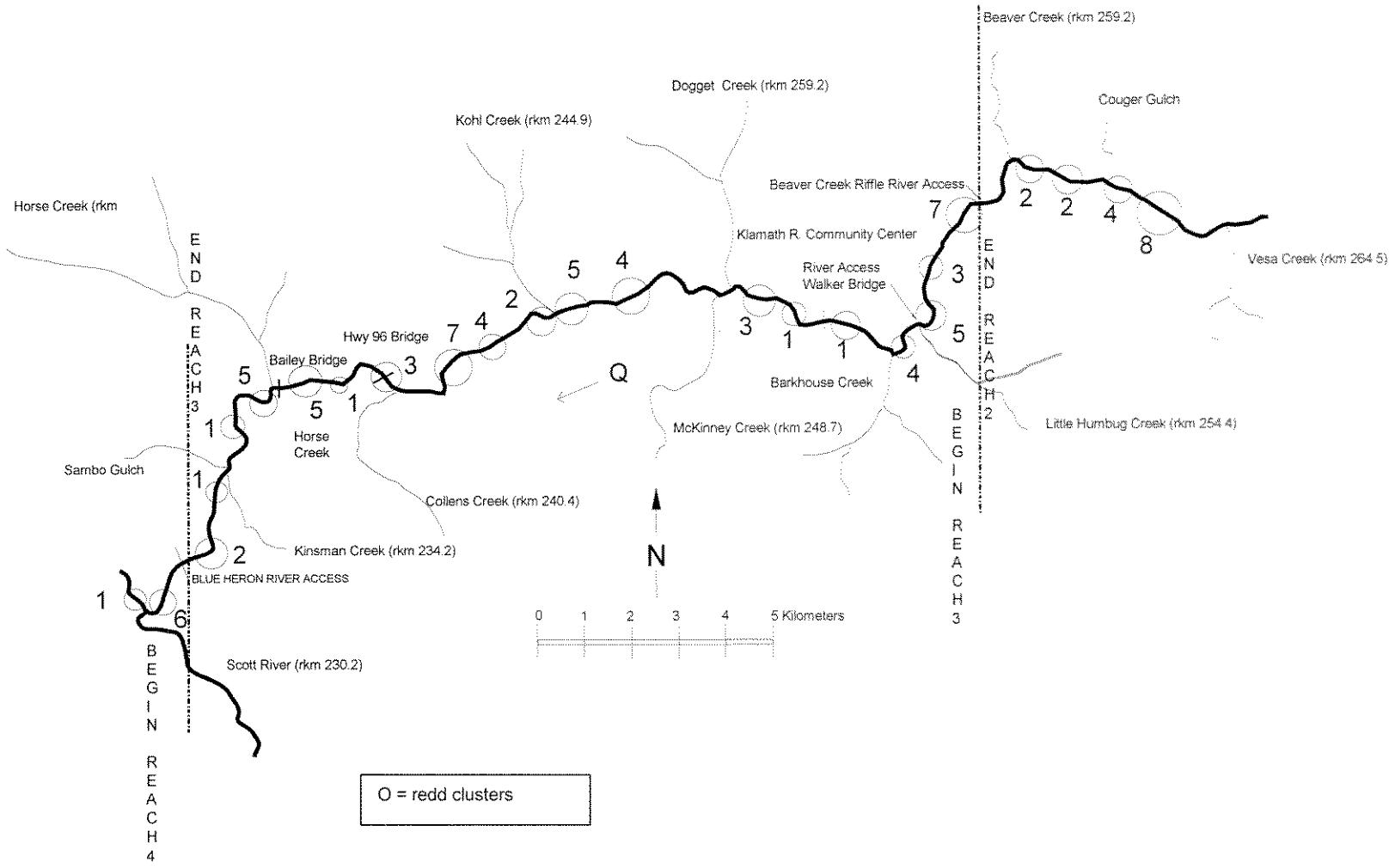

Figure 5. Redd distribution map for 1999, mainstem Klamath River, Vesa Creek to Scott River.

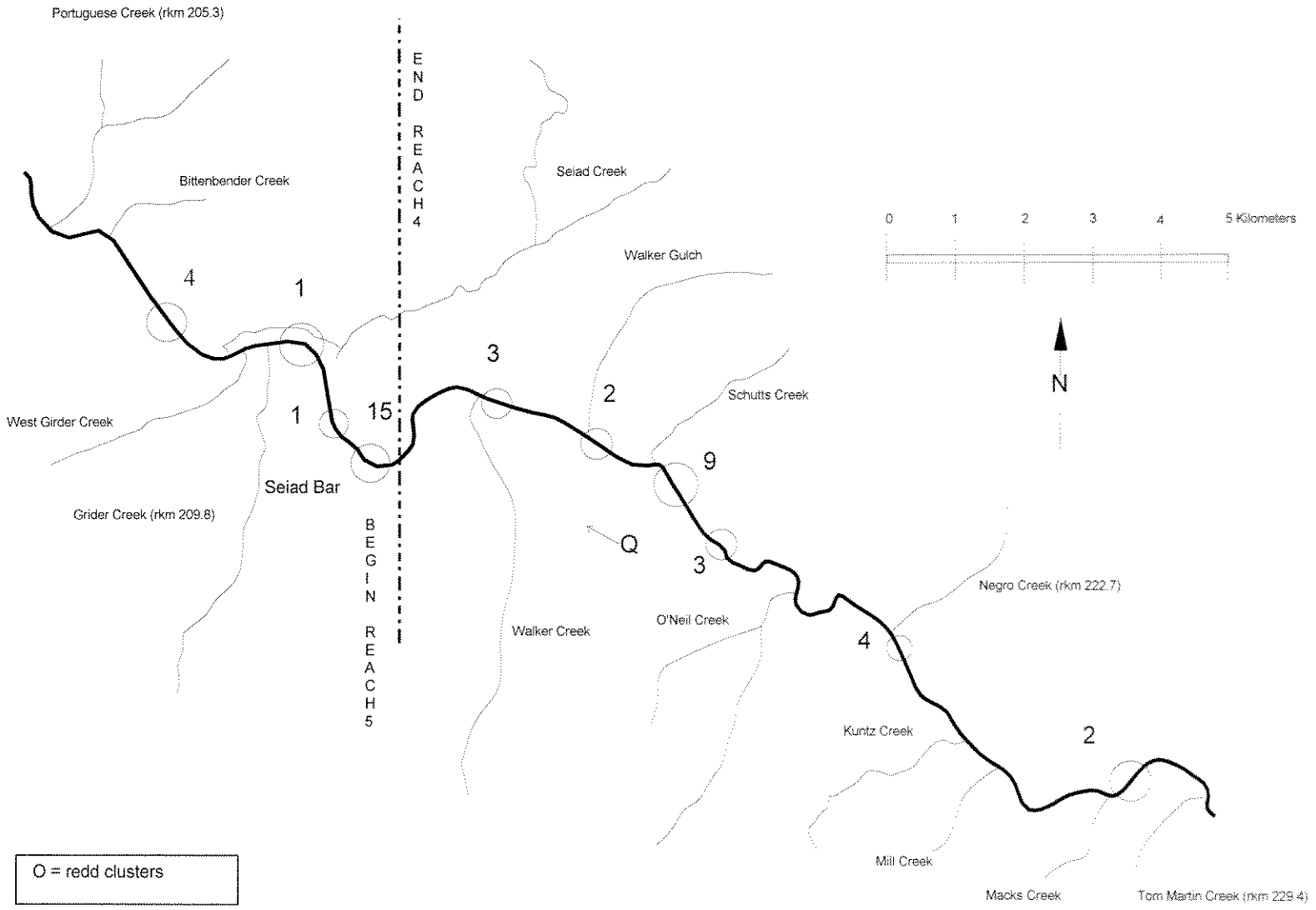

Figure 6. Redd distribution map for 1999, mainstem Klamath River, Tom Martin Creek to Portuguese Creek.

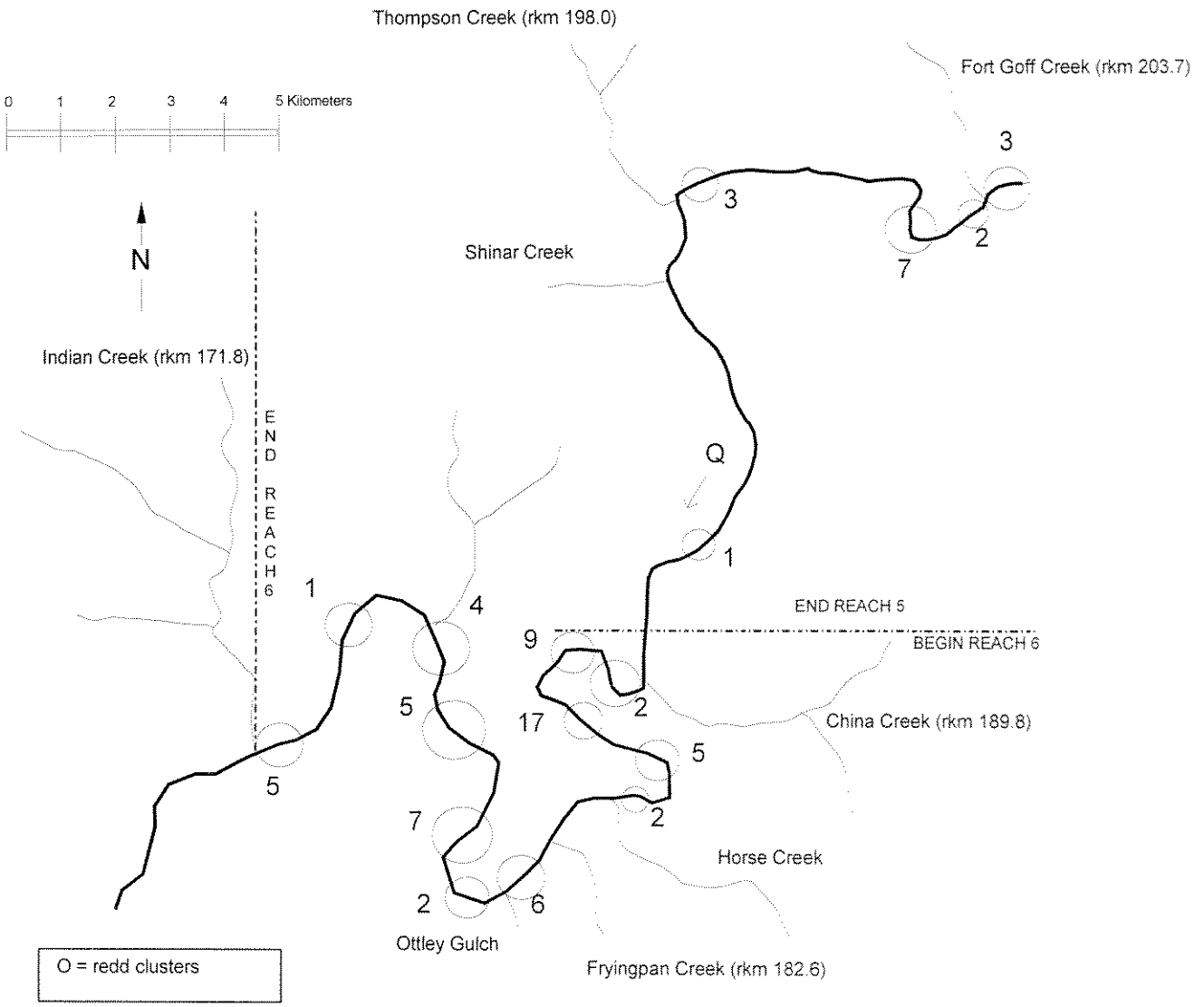

Figure 7. Redd distribution map for 1999, mainstem Klamath River, Fort Goff Creek to Indian Creek.

with the largest increase occurring after 1996 (Figure 8). A very similar trend appears for the section between Cape Horn Creek and the Shasta River confluence. Combined, these two upper mainstem sections account for over 73% of the 1999 total redd count with the remaining 27% of the redds distributed between Shasta River and Indian Creek. The lowest redd densities (0.3 redds/rkm) of any 10 rkm section were between Shinar Creek and China Creek.

Redd Data

Thirteen potential redds were eliminated from the 1999 count because they were either incomplete or not believed to be chinook redds. Most of these appeared to be complete redds with a pit and mound but were small (<1.0 m^2) in size.

Single and multiple redd clusters were predominately located by the right bank (41.7%), followed by the left bank (37.2%), mid channel (11.0%), and side channels (10.8%).

Water Temperature

Mean daily water temperatures decreased from 15.8 to 10.2°C during this survey (October 13 and November 19, respectively). When IGD flows increased from 1,360 to 1,810 cfs during October 27 to 29, water temperatures dropped from 13.3 to 12.7°C (Figure 9).

Discharge

During this survey, mean daily river discharge at IGD ranged from 1,360 to 1,820 cfs (Figure 9). During October 13 to 27, discharge ranged from 1,360 to 1,380 cfs. On October 28, flows were ramped up to 1,800 to 1,820 cfs and remained at this level for the remainder of the surveys. These high flows may have had an influence on the number and location of redds since water velocity and depth are important in redd placement (Reiser and Bjornn 1979). High flows limited redd identification and counts because water clarity decreased immediately after discharges from IGD increased. After several days of higher flows, water clarity improved but did not return to that observed during pre high flow levels.

Water Clarity

Vertical Secchi disc readings ranged from 1.5 to 2.7m during this survey. The 2.7m reading was made on October 19 (between IGD and Hwy I-5) with the 1.5m reading being made on November 18 (between Seiad and China Point). Generally, water clarity decreased with higher river discharge, cloud cover, and precipitation.

Suction Dredge Mining

Recreational suction dredge mining was present throughout the survey from the I-5 Bridge to Happy Camp. There was only one redd observed this year on suction dredge tailings. Studies have indicated that redds constructed on dredge tailings are more unstable in high flows than those on naturally deposited substrate (Harvey and Lisle 1999).

Adult Grilse Expansion

The CDFG estimated the natural fall chinook spawner escapement for the mainstem Klamath River for 1999 at 1,978 adults and 367 grilse (Table 3). The adult/grilse estimates are based on male to female ratio and jack percentages observed at upper Klamath River tributary weirs (Pisano 2000).

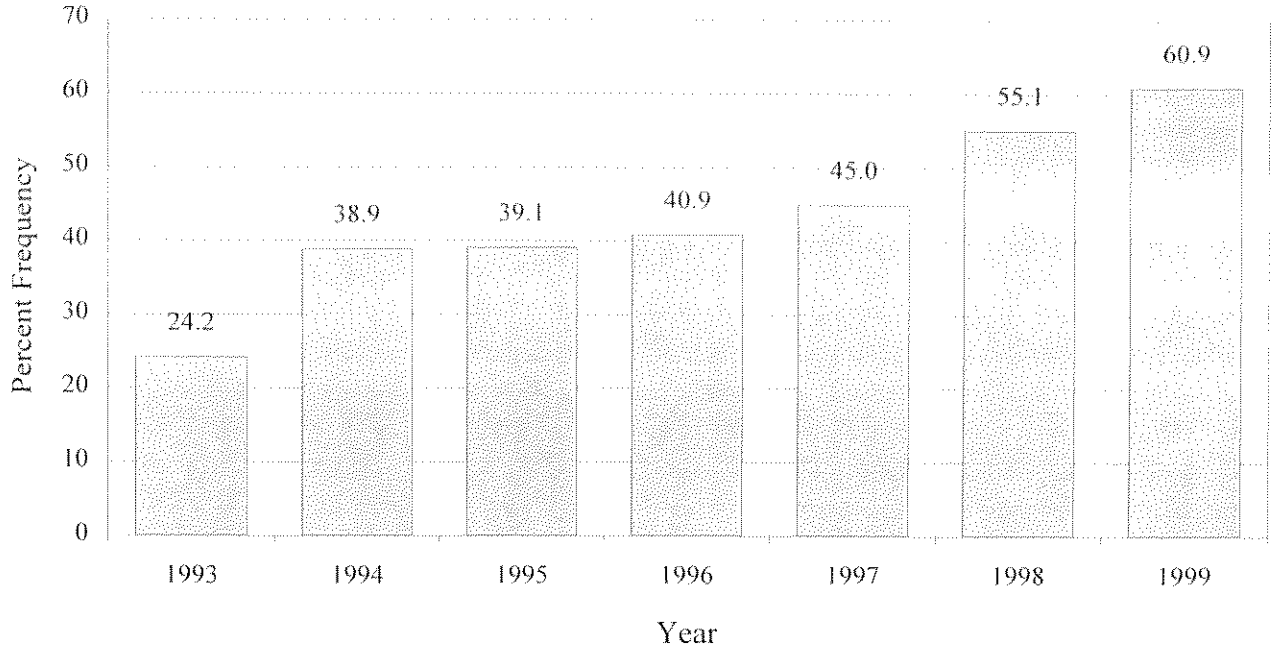

Figure 8. Percent frequency of redds by year (1993 to 1999) from Iron Gate Dam to Cape Horn Creek.

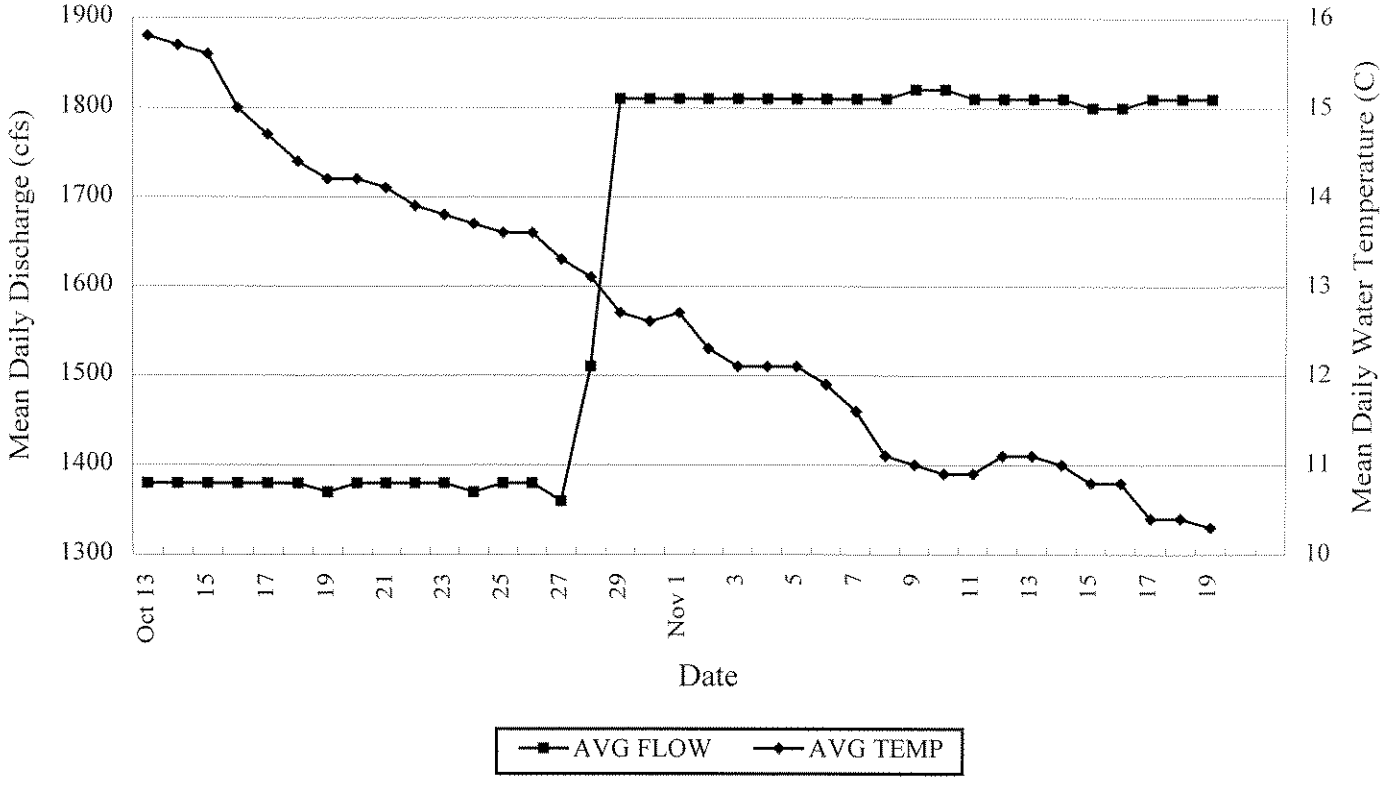

Figure 9. Mean daily water temperature (°C) at rkm 300.4 and mean daily discharge from Iron Gate Dam (October 13 to November 19, 1999).

Based on spawning data from mainstem and tributary spawning surveys conducted by AFWO, USFS, CDFG, and Hoopa and Yurok tribes, the CDFG estimated that 34,634 adults spawned in-river or at hatcheries within the Klamath River Basin. This low escapement is similar to that of 1993 (43,501). However, the relatively high number of grilse in 1999 is encouraging.

Table 3. Natural fall chinook spawning escapement adult and grilse expansion, Klamath River, 1999 (Pisano 2000).

Natural Spawning Area	Grilse	Adults	Totals
Salmon River Basin	107	655	762
Scott River Basin	540	2,906	3,446
Bogus Creek Basin	1,557	4,608	6,165
Mainstem Klamath River	367	1,978	2,369
Misc. Klamath River tributaries	140	762	902
Total Natural Spawners	2,711	10,909	13,644

SUMMARY

The fall chinook redd count of 989 was the second lowest number observed since the initiation of these surveys in 1993 when 330 redds were counted. The highest redd count was 3,236 redds observed in 1995. Since 1993, the tendency for chinook to spawn in the upper 10 rkm between IGD and Cape Horn Creek has increased from 24 to 61%, with a corresponding decrease in spawning downstream.

Peak mainstem chinook spawning occurred during the Week 3 (October 25 to 27) in the area between IGD and the Shasta River and peaked during Week 2 (October 18 to 22) in the area downstream of the Shasta River. However, if complete surveys in Reaches 2 to 6 were initiated during the same week as surveys in Reach 1 (Week 1), then peak spawning may not have been during Week 2 of the survey (Table 1). An earlier survey may have placed peak mainstem spawning downstream of Shasta River around the same time that adult chinook returns to (IGH) peaked, October 12 to 18. A possible explanation for the difference in spawning timing between IGH and mainstem chinook between IGD and the Shasta River is that not all chinook entering IGH were ready to spawn and were held 3 to 5 days prior to spawning (K. Rushton, CDFG, personal communication).

The age composition of the 1999 mainstem spawners consisted primarily of three year old fish (1996 brood year) (Pisano 2000). The low 1999 redd count (989) may have been due to the January 1, 1997, flood which probably resulted in redd scouring and decreased survival of eggs and pre emergent juveniles. A continuous decline in redds observed in downstream river reaches after the flood and a change in the distribution of spawning areas seems to indicate that the spawning habitat has not totally recovered to the pre 1996 levels.

REFERENCES

Harvey, B.C. and T.E. Lisle. 1999. Scour of Chinook Salmon Redds on Suction Dredge Tailings. North American Journal of Fisheries Management 19:613-617.

PFMC (Pacific Fishery Management Council). 1988. Review of 1988 ocean salmon fisheries. Portland, Oregon.

Pisano, M. 2000. Klamath River Basin fall chinook salmon spawner escapement, in-river harvest and run-size estimates 1978-1999. CDFG. Klamath-Trinity Program. Field Observations.

Reiser, D.W. and Bjornn. 1979. Habitat requirements of anadromous salmonids. General Technical Reports PNW-96. USDA Forest Service, Portland, OR 56pp.

USFWS 1991. Annual Report: Klamath River Fisheries Assessment Program, 1989. Coastal California Fishery Resource Office, Arcata, CA

PERSONAL COMMUNICATIONS

Rushton, K. 2000. California Department of Fish and Game, Hornbrook, Calif.

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